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SEDIMENTARY CHRYSOPHYCEAN CYST ASSEMBLAGES AS PALEOINDICATORS IN ACID SENSITIVE LAKES

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ABSTRACT

Relationship between surface sediment cyst assemblages and lake-water characteristics were studied in 50 lakes located in central Ontario. The main purposes of the study were to identify the environmental factors most strongly controlling the distribution of chrysophycean cysts and to develop indices and equations to infer lake water pH from cyst assemblages.

Surface sediment samples were collected from a total of 50 lakes in the Killarney-Perry Sound-Muskoka-Haliburton region of Ontario. The lakes were chosen to represent a wide variety of central Ontario lake-watershed systems (see also Griffiths et al., 1988)

Principal components analysis indicates that TDS and associated lakewater pH as well as elements related to trophic status are the most important factors controlling the distribution of chrysophycean cysts. There are significant differences in the relative importance of these factors among the lakes. Generally, the large number of significant correlations suggests that chrysophycean cyst distribution is influenced by one or more of the six environmental factors. Most of the morphotypes seem to be significantly correlated with alkalinity and lakewater pH (21 taxa), while 19 morphotypes appear to be correlated with trophic status of the lake. The results suggests that due to complexity of variables such as pH and trophic status, which can be influenced by several environmental interactions, there could be differences in the level of importance of several environmental factors controlling the distribution of cysts.

Several techniques were used to develop equations for inferring lakewater pH from fossil chrysophycean cyst assemblages. Calibration equations 1 and 2 (Table 1) predicted surface-water pH most adequately and the precision of those equations was the best.

Table 1 Regression equations for inferring pH from fossil chrysophycean cyst assemblages. All relationship are highly significant (P<0.0001)

Equations	
1. $pH=7.07+0.193C_{14}-0.153C_{24}-0.031C_{62}-0.327C_{68}+0.176C_{80}-0.119C_{83}-0.107C_{85}-0.280C_{107}-0.331_{AA}$	R=0.97 SE=0.19 n=45
2. $pH=5.836-0.13Acb-0.023Acf0.0148I+0.051Alkf+0.0294Alkb$	R=0.95 SE=0.22 n=45

were
C_n - % abundance of the (n) morphotype
Acb - % abundance of Acidobiontic forms
Acf - % abundance of Acidophilous forms
I - % abundance of Indifferent forms
Alkf- % abundance of Alkaliphilous forms
Alkb- % abundance of Alkalibiontic forms

The equations can be recommended for paleoecological studies and are applicable for investigations of a wide pH range of Ontario lake types. It should be noticed that in order to increase the confidence of ecological interpretations based on the derived equations, it was necessary to estimate the relative precisions of cyst-predicted values using data from lakes that were not a part of the calibration lake set (.i.e. the validations lakes); Raven, Maggie, Papineau, Diamond and White). The regression of the pH predicted from equation 1 against the measured has a very high correlation coefficient (R=0.99); SE+).18) and the pH estimated by this equation does not differ significantly (i.e. the intercept and the slopes do differ significantly from zero and one, respectively) from that measured in the validation lakes. Although the relationship between the predicted and measured pH in the validation lakes have a very high R values based on other derived equations.

The study also provides a descriptive analysis of the "fossil" chrysophycean cyst flora from Ontario lakes. The descriptions include representative SEM micrographs and detailed characterization of each morphotype in consideration of the morphological variation observed among specimens of the same morphotype. Special attention has been paid to the anatomy of the collar complex and to the nature of the cyst surface ornamentation. One hundred thirty seven morphotypes are described, most of them for the first time.

The present study as well as previous investigations (Rybak, 1986; Rybak, 1987; Rybak et al., 1987) show a great potential for using chrysophycean cysts as paleoindicators.

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